

Corporate Finance

Corporate Finance

Marc Deloof
Sophie Manigart
Hubert Ooghe
Cynthia Van Hulle

Marc Deloof, Sophie Manigart,
Hubert Ooghe en Cynthia Van Hulle

Corporate Finance

This textbook on Corporate Finance deals with the different sources of funding and the capital structure of corporations (excluding financial institutions), the decisions that managers can take to increase enterprise value as well as the tools and analysis used to allocate financial resources.

The authors link theoretical insight to practical cases. The objectives and functions of corporate finance are discussed in an introductory chapter. The following chapters cover: fundamental financial valuation principles, investment analysis and the minimum investment return requirement, capital structure and dividend policy, long-term and medium-term financing, working capital as well as some specific financial topics such as valuation of companies, international financial policy, financing of growth companies, mergers and acquisitions, etc.

While written for students, this book is also appealing to financial professionals such as financial directors, credit rating agencies, corporate managers in financial institutions as well as accountants and auditors.

ISBN 978-1-78068-654-7



9 781780 686547

www.intersentia.com



intersentia

CORPORATE FINANCE

Marc Deloof
Sophie Manigart
Hubert Ooghe
Cynthia Van Hulle



intersentia

Cambridge – Antwerp – Chicago

Intersentia Ltd
Sheraton House | Castle Park
Cambridge | CB3 0AX | United Kingdom
Tel.: +44 1223 370 170 | Fax: +44 1223 370 169
Email: mail@intersentia.co.uk
www.intersentia.com | www.intersentia.co.uk

Distribution for the UK and Ireland:

NBN International
Airport Business Centre, 10 Thornbury Road
Plymouth, PL6 7 PP
United Kingdom
Tel.: +44 1752 202 301 | Fax: +44 1752 202 331
Email: orders@nbninternational.com

Distribution for Europe and all other countries:

Intersentia Publishing nv
Groenstraat 31
2640 Mortsel
Belgium
Tel.: +32 3 680 15 50 | Fax: +32 3 658 71 21
Email: mail@intersentia.be

Distribution for the USA and Canada:

Independent Publishers Group
Order Department
814 North Franklin Street
Chicago, IL60610
USA
Tel.: +1 800 888 4741 (toll free) | Fax: +1312 337 5985
Email: orders@ipgbook.com

Corporate Finance

© 2019 Marc Deloof, Sophie Manigart, Hubert Ooghe and Cynthia Van Hulle

The authors have asserted the right under the Copyright, Designs and Patents Act 1988, to be identified as author of this work.

No part of this book may be reproduced, stored in a retrieval system, or transmitted, in any form, or by any means, without prior written permission from Intersentia, or as expressly permitted by law or under the terms agreed with the appropriate reprographic rights organisation. Enquiries concerning reproduction which may not be covered by the above should be addressed to Intersentia at the address above.

ISBN 978-1-78068-654-7
D/2019/7849/13
NUR 782

British Library Cataloguing in Publication Data. A catalogue record for this book is available from the British Library.

Contents

<i>List of tables</i>	xix
<i>List of figures</i>	xxiii

CHAPTER 1.

OBJECTIVES AND FUNCTIONS OF FINANCIAL MANAGEMENT	1
1. Introduction	3
1.1. The role of the finance director	3
1.2. The objective of the company from a financial point of view	4
1.2.1. Which objective?	4
1.2.2. Corporate governance: management versus shareholders	5
1.2.3. Maximising the value of the company as a normative objective	7
1.3. Classification of the financial function	9
1.3.1. Investment decisions (assets)	9
1.3.2. Financing decisions (liabilities)	9
1.3.3. Dividend decisions	9
1.3.4. Special decisions	9
1.3.5. Financial management	10
1.4. Perfect capital markets, efficient capital markets and the (vain?) search for high returns on investment	10
1.4.1. A perfect capital market: an unrealistic ideal	11
1.4.2. From perfect capital markets to efficient capital markets	11
References	14

PART 1.

FUNDAMENTAL VALUATION PRINCIPLES

CHAPTER 2.

BASIC VALUATION CONCEPTS 17

Introduction 19

2.1. Single amount, to be received or paid after one year..... 19

2.1.1. Future value after one year 19

2.1.2. The current or present value of a future money flow after one year 20

2.2. Single amount, to be paid or received after n years 21

2.3. Impact of the interest or discount factor..... 24

2.4. Interest periodicity less than one year 26

2.4.1. Present value with a periodicity less than one year 28

2.5. Future and present value of a series of different money flows 29

2.6. Present value of a series of equal money flows..... 30

2.6.1. Infinite series of equal money flows..... 30

2.6.2. Infinite series, constantly growing money flows 30

2.6.3. Finite series of equal money flows 31

2.7. Nominal and real interest rates on loans with a periodicity less than one year..... 32

CHAPTER 3.

VALUATION OF (BOND) LOANS AND SHARES 35

Introduction 37

3.1. Valuation of simple (bond) loans 37

3.1.1. The valuation model..... 37

3.1.2. Impact of changes of the remaining term and of the required rate of return . 38

3.1.3. Determinants of the required rate of return 39

3.1.4. Zero-coupon bonds 43

3.2. Valuing shares based on dividends 46

3.2.1. Investment horizon of one year 47

3.2.2. General dividend valuation model..... 48

3.2.3. Growth models 50

CHAPTER 4.	
THE RELATIONSHIP BETWEEN THE REQUIRED RATE OF RETURN AND RISK	55
Introduction	57
4.1. Lessons from history	57
4.2. Determining the risk	58
4.2.1. Average rate of return and risk	58
4.2.2. Standard deviation: a measure of risk	59
4.2.3. Risk and rate of return in financial theory: overview of the assumptions .	60
4.3. Attitude towards risk	61
4.3.1. Risk aversion	61
4.3.2. Risk neutrality	62
4.3.3. Risk seeking	63
4.3.4. Exceptions to the assumption of risk aversion	64
4.4. The 'efficient set theorem' and risk	65
4.4.1. Assessment of wealth in relation to risk	65
4.4.2. The 'efficient set theorem'	66
4.4.3. Efficient set theorem and the utility function	66
4.4.4. Example	67
4.5. Calculating the expected rate of return and risk	69
4.5.1. Calculating the expected rate of return (E(R))	70
4.5.2. Calculation of the expected risk ($\sigma^2(R)$)	71
4.6. The effect of diversification: investing in multiple shares	72
4.6.1. Combinations of two shares	72
4.6.2. Investing in more than two shares	75
4.6.3. Investing in a risky and a risk-free investment	78
4.7. The Capital Market Line	79
4.8. The required rate of return for an individual share	81
4.8.1. Derivation of the Capital Asset Pricing Model (CAPM)	81
4.8.2. What is shown by the CAPM?	84
4.8.3. Risk-free interest rate, market portfolio and market risk premium	84
4.9. Beta as a measure of risk	85
4.9.1. <i>Ex post</i> versus <i>ex ante</i> rates of return	85
4.9.2. Sensitivity to the market	85
4.9.3. Risk in Europe and Belgium	87
4.9.4. Calculation of beta in practice	88

4.9.5.	The beta of a portfolio	90
4.9.6.	Beta stability	90
4.10.	Detecting overvalued and undervalued shares using CAPM.	91
4.10.1.	Definition of overvaluation and undervaluation	91
4.11.	Alternative models	92
4.11.1.	The Arbitrage Pricing Model (APM)	92
4.11.2.	Examples of additional risk factors ('fudge factors')	93
	References	96
CHAPTER 5.		
VALUING OPTIONS.		
		97
	Introduction	99
5.1.	Definition.	99
5.1.1.	The right.	100
5.1.2.	Limited duration.	100
5.1.3.	Exercise price	100
5.1.4.	The underlying asset.	100
5.1.5.	Buying or selling.	100
5.2.	Value of an option on exercise date	101
5.2.1.	Position of the buyer of the option.	101
5.2.2.	The buyer's right is the seller's obligation	103
5.3.	Valuation of options: qualitative approach	105
5.3.1.	End value	105
5.3.2.	Time value	106
5.4.	Valuation of options: quantitative approach.	112
5.4.1.	Binomial method	112
5.4.2.	Binomial method: now also in two steps	116
5.4.3.	The Black & Scholes formula	117
5.4.4.	Valuing a put option.	118
5.4.5.	American options.	121
5.4.6.	Implied volatility.	121
	References	122
	Appendix 5.1.	123

PART 2.
INVESTMENT ANALYSIS AND COST OF CAPITAL

CHAPTER 6.
ASSESSING INVESTMENT PROJECTS 129

Introduction 131

6.1. Determining cash flows 131

6.1.1. General basic principles 131

6.1.2. Sunk costs 132

6.1.3. Opportunity costs 133

6.1.4. Side effects 133

6.1.5. The useful life of the project 134

6.2. Example: an expansion investment 134

6.2.1. Determining the impact on the annual result 136

6.2.2. Determining the change in the need for net working capital 136

6.2.3. Determining investment cash flows 137

6.3. Evaluation methods 138

6.3.1. Average book profitability 138

6.3.2. Payback period 139

6.3.3. Internal Rate of Return (IRR) 140

6.3.4. Net Present Value Method (NPV) 141

6.4. Comparison of net present value and internal rate of return 142

6.4.1. A single project 142

6.4.2. Mutually exclusive projects 144

CHAPTER 7.
FURTHER REFINEMENTS IN ASSESSING THE INVESTMENT 149

Introduction 151

7.1. The impact of inflation 151

7.1.1. Inflation and interest 151

7.1.2. Inflation and investment projects 152

7.2. Capital rationing 154

7.3. Projects with different lifetimes 155

7.4. Real options in investment projects 157

7.4.1.	The importance of real options in strategic investment projects.....	157
7.4.2.	A comparison of financial and real options	159
7.4.3.	Example: option to stop a project.....	160
	References	163

CHAPTER 8.

	COST OF CAPITAL.....	165
8.1.	Basic principles of the cost of capital	167
8.2.	Required rate of return on ordinary share capital	168
8.3.	The cost of preference shares	169
8.4.	The cost of debt financing	170
8.5.	The weighted average cost of capital of a company	171
8.6.	The required rate of return on an investment project in a diversified company	175
8.6.1.	Systematic risk of a diversified company.....	175
8.6.2.	Example	175
8.6.3.	Rule of thumb when evaluating projects.....	177
8.6.4.	Uncoupling of the investment decision from the financing decision	177

PART 3.

FINANCING AND DIVIDEND STRATEGY

CHAPTER 9.

	IS THE CAPITAL STRUCTURE OF ANY IMPORTANCE?	181
	Introduction	183
9.1.	Maximising corporate value and shareholder value	183
9.2.	Modigliani and Miller: the capital structure is of no importance in a perfect capital market	184
9.2.1.	The impact of the capital structure on corporate value.....	184
9.2.2.	The impact of the capital structure on the return to the shareholders ...	186
9.2.3.	Impact of the capital structure on the cost of capital.....	190
9.3.	The impact of corporate taxes.....	192
9.3.1.	The impact of corporate taxes on the value of a company	192

9.3.2.	The impact of corporate taxes on the cost of capital and the cost of equity	195
9.3.3.	The impact of notional interest deduction on equity in Belgian companies	195
9.4.	Bankruptcy costs	198
9.4.1.	Payment problems	198
9.4.2.	Conflicts of interest and information problems	199
9.4.3.	Costs associated with a possible bankruptcy	200
9.4.4.	The impact of bankruptcy costs on the capital structure	201
	References	204
CHAPTER 10.		
OTHER ASPECTS OF THE CAPITAL STRUCTURE.		205
	Introduction	207
10.1.	Taxes	207
10.1.1.	Corporate and personal income taxes	207
10.1.2.	The Miller theory	210
10.1.3.	The effect of taxes in summary	211
10.2.	Conflicts of interest between shareholders and creditors	212
10.2.1.	Agency relation between shareholders and creditors	212
10.2.2.	Strategies of shareholders at the expense of creditors	213
10.2.3.	Restrictions for the company	216
10.3.	Equity and loan capital as options	216
10.4.	Conflicts of interest between shareholders and managers	218
10.5.	The pecking order theory of capital structure	220
	References	222
CHAPTER 11.		
DIVIDEND POLICY		223
11.1.	Dividend policy at Belgian companies	225
11.2.	Dividend policy is irrelevant in a world with perfect capital markets ...	226
11.2.1.	Example: dividend policy and value	226
11.2.2.	Conclusion	230

11.3.	Dividend policy in imperfect capital markets: relevance to valuation . . .	230
11.3.1.	Taxes	231
11.3.2.	Which taxes influence dividend policy?	232
11.3.3.	How do taxes affect dividend policy?	233
11.4.	Other imperfections	236
11.4.1.	The clientele effect (especially important for listed companies)	236
11.4.2.	Asymmetric information (especially important for listed companies) . . .	237
11.4.3.	Agency problems and corporate governance (especially important for listed companies)	240
11.5.	Conclusion: rules of thumb for financial managers.	240
11.6.	Dividend policy in Belgium at listed companies	242
CHAPTER 12.		
OTHER ASPECTS OF DIVIDEND POLICY 245		
Introduction 247		
12.1.	Dividend policy in practice.	247
12.1.1.	The Lintner model	247
12.1.2.	Dividend stability	248
12.1.3.	Regular and extra dividends	250
12.2.	Stock dividend.	251
12.2.1.	What is a stock dividend?	251
12.2.2.	Value of the stock dividend.	251
12.2.3.	Optional dividend	253
12.3.	Stock split.	254
12.3.1.	What is a stock split?	254
12.3.2.	Value of a stock split.	255
12.3.3.	Consolidation of shares	256
12.4.	Repurchase of stock	257
References 262		

PART 4.	
MEDIUM- AND LONG-TERM FINANCING	
CHAPTER 13.	
ISSUING SHARES	265
13.1. Shares	267
13.1.1. Characteristics	267
13.1.2. Rights of shareholders	268
13.1.3. Preferred stock	270
13.2. Organised stock markets	274
13.3. Public issue of shares	275
13.1.3. Public issue versus private placement	275
13.2.3. The role of investment banks	277
13.3.3. Pricing	278
13.3.4. Other characteristics of a public issue	279
13.3.5. ‘Underpricing’ of IPOs	280
13.3.6. An example: the Alfacam IPO	281
13.4. Rights offering of shares	283
13.4.1. Rights offering and preferential right	283
13.4.2. Value of the preferential rights	285
13.4.3. Success or failure of a rights offering	288
13.5. Advantages and disadvantages of a stock exchange listing	290
References	293
CHAPTER 14.	
MEDIUM-TERM AND LONG-TERM DEBTS	295
Introduction	297
14.1. The credit decision	299
14.1.1. General principles	299
14.1.2. Protective clauses or covenants	299
14.1.3. Collateral	302
14.2. Types of credit provided by financial institutions	303
14.2.1. Term loans	303
14.2.2. Revolving credit	304
14.2.3. Mortgage credit	304

14.2.4.	Equipment credit	304
14.3.	Bonds: introductory concepts.....	305
14.4.	Types of bonds	306
14.5.	Bonds with a call (or early redemption) option.....	309
14.5.1.	The early repayment clause.....	309
14.5.2.	Value of the call option upon exercise.....	311
14.6.	Bonds with warrants	313
14.6.1.	Definition and characteristics.....	313
14.6.2.	Valuation of a bond with warrant.....	316
14.7.	Convertible bonds	319
14.7.1.	Definitions.....	319
14.7.2.	The cost and valuation of a convertible bond.....	321
14.7.3.	Why are convertible bonds issued?	323
14.8.	Lease.....	324
14.8.1.	Finance lease and operating lease.....	324
14.8.2.	Special forms of financial lease.....	326
14.8.3.	Accounting treatment	327
14.8.4.	Tax treatment	327
14.8.5.	Advantages to lease.....	328
	References	330

PART 5.
WORKING CAPITAL MANAGEMENT

	CHAPTER 15. WORKING CAPITAL MANAGEMENT AND FINANCIAL PLANNING.....	333
	Introduction	335
15.1.	The hedging approach to the financing maturity.....	335
15.2.	The impact of the working capital requirement.....	337
15.3.	Financial planning as a means to estimate financial needs.....	342
15.3.1.	Example	342
15.3.2.	Determining the operating cash flow	343
15.3.3.	Total cash flow.....	345

15.4.	Concluding observations on financial planning	346	
15.4.1.	Sensitivity and scenario analysis.....	346	
15.4.2.	Planning horizon and periodicity of planning.....	347	
CHAPTER 16.			
MANAGEMENT OF ACCOUNTS RECEIVABLE			349
16.1.	Why do companies grant commercial credit?	351	
16.2.	Strategic aspects of accounts receivable management.....	352	
16.3.	Determining payment policy	353	
16.3.1.	Instruments of payment policy.....	353	
16.3.2.	Analysis of customer payment behaviour.....	355	
16.4.	Impact of various elements of the credit policy	356	
16.5.	Credit assessment of the individual customer	358	
16.5.1.	Information collection.....	358	
16.5.2.	Credit analysis.....	359	
16.5.3.	Credit decision	361	
16.6.	Other aspects of credit policy	361	
16.6.1.	Collection procedures	361	
16.6.2.	Credit insurance	362	
16.6.3.	Factoring	362	
References		365	
CHAPTER 17.			
OPERATIONAL SHORT-TERM FINANCING			367
17.1.	Accounts payable	369	
17.1.1.	Forms of accounts payable	369	
17.1.2.	Accounts payable as financing tool	370	
17.1.3.	Payment on due date	371	
17.1.4.	Payment after due date.....	373	
17.1.5.	Advantages of supplier credit	373	
17.2.	Other liabilities payable within one year.....	375	

CHAPTER 18.
MANAGING SHORT-TERM CASH SURPLUSES AND DEFICITS 379

18.1. Techniques to optimise cash management 382

18.1.1. Netting 382

18.1.2. In-house bank 383

18.1.3. Cash pooling 383

18.2. Split between cash and cash investments 385

18.2.1. The inventory model 385

18.2.2. Stochastic models: Miller–Orr 387

18.2.3. Probabilistic approach 388

18.3. Cash investments 389

18.3.1. Default risk 389

18.3.2. Saleability 389

18.3.3. Maturity 389

18.3.4. Portfolio management 391

18.4. Short-term financial debts with banks 392

18.4.1. Cash credit or overdraft facility 392

18.4.2. Advances against approved progress reports 393

18.4.3. Straight loans 393

18.4.4. Revolving credits 393

18.4.5. Short-term credits with guarantees 394

18.4.6. Interest calculation 394

18.5. Commercial paper 394

References 396

PART 6.
SPECIAL TOPICS

CHAPTER 19.
VALUATION OF COMPANIES 399

Introduction 401

19.1. The discounted cash flow (DCF) model of a debt-free company 401

19.1.1. General considerations 401

19.1.2. Basic assumptions 402

19.1.3. The future FCF increases by a constant percentage 404

19.1.4. The future FCFs show a different growth pattern 404

19.2.	The company is financed with equity and debt	407
19.2.1.	Determining the FCFs	407
19.2.2.	Determining the cost of capital	408
19.2.3.	Determining the enterprise value and the value of equity	409
19.2.4.	The balance sheet expressed in market value	410
19.3.	Comparison with similar companies (multiples).	411
19.3.1.	Principles	411
19.3.2.	Valuation based on equity multiples	412
19.3.3.	Valuation based on a company's enterprise value multiples.	413
19.3.4.	Pros and cons of using the multiple valuation method.	413
19.4.	Concluding remarks.	414
 CHAPTER 20.		
MERGERS AND ACQUISITIONS.		
20.1.	Forms of combining companies	419
20.2.	Tax and accounting treatment	420
20.2.1.	Tax treatment	420
20.2.2.	Accounting treatment	421
20.3.	The synergy value of mergers and acquisitions	422
20.4.	Reasons for mergers and acquisitions	423
20.4.1.	Operational savings and economies of scale.	423
20.4.2.	Lower cost of capital.	423
20.4.3.	Replacing inefficient managers.	424
20.4.4.	Diversification.	424
20.4.5.	Tax savings.	425
20.4.6.	Internal versus external growth	425
20.4.7.	Increase in earnings per share	426
20.5.	Impact of mergers and acquisitions on enterprise value.	427
20.5.1.	Exchange ratio and value per share	427
20.5.2.	Method of payment and value per share.	429
20.5.3.	Empirical research	433
20.6.	Public takeover bid.	433
20.7.	Demergers	436

CHAPTER 21.	
FINANCING GROWTH-ORIENTED YOUNG COMPANIES	439
Introduction	441
21.1. The financial need	441
21.2. Differences between financing established companies and young or growth-oriented companies	443
21.3. Financing parties	445
21.4. Rate of return	448
21.5. Crowdfunding	453
21.6. Concluding remarks	454
References	454
CHAPTER 22.	
INTERNATIONAL FINANCIAL POLICY	455
Introduction	457
22.1. Investing abroad	457
22.1.1. Risk considerations	457
22.1.2. Yield considerations	458
22.1.3. Tax regime	458
22.1.4. Political risk	458
22.2. Foreign exchange risks	460
22.2.1. Exchange rate determinants	460
22.2.2. What exchange risks do companies face?	467
22.2.3. Hedging techniques	470
22.2.4. Why hedge foreign exchange risks?	473
22.3. Payment and financing international trade	476
22.3.1. Payment in international trade: the letter of credit	477
22.3.2. Financing international trade	478
References	479

List of tables

Table 2.1.	Principle of compound interest	22
Table 2.2.	Value of 1 euro invested for n years at an interest rate i	24
Table 2.3.	Current or present value of 1 euro, received after n years, at a discount factor of i	25
Table 2.4.	Present value of 100 euros after 3 years	29
Table 3.1.	Market value of a loan with nominal value 1,000 and 5% coupon interest rate, depending on the required rate of return and the remaining term	38
Table 3.2.	Classification of bonds by Standard & Poor's and Moody's	41
Table 3.3.	Value of a zero-coupon bond with a nominal value of 1,000, depending on the required rate of return and the remaining term.	44
Table 4.1.	Annual historical rate of return of four shares.	68
Table 4.2.	Rate of return and risk of a portfolio of Colruyt and Bekaert shares	73
Table 4.3.	Examples of betas for European and Belgian companies.	87
Table 4.4.	Calculation of beta.	89
Table 5.1.	Listing of call options on the Arcelor Mittal share on the AEX options exchange on 5 August 2008.	109
Table 5.2.	Listing of the call options on the TomTom share on the AEX options exchange on 5 August 2008	110
Table 5.3.	Listing of a number of calls on the AEX on 23 August 2002	111
Table 6.1.	Cash flows from the investment project (all amounts in 1 000 euros)	135
Table 6.2.	Cash flows from two mutually exclusive projects	145

Table 6.3.	Cash flows from project Y versus project X	146
Table 7.1.	Examples of real options	159
Table 8.1.	Impact of taxes on the cost of debts.	171
Table 8.2.	Example of calculating the weighted average cost of capital	173
Table 9.1.	Balance sheet of company Achilleus _{EQ}	185
Table 9.2.	Balance sheet of company Achilleus _D	185
Table 9.3.	Profit per share in three scenarios, with and without debt financing	187
Table 9.4.	Personal debt financing and financing strategy	189
Table 9.5.	The impact of corporate taxes	193
Table 10.1.	The impact of personal income tax	208
Table 10.2.	Interest cost after corporate and personal income tax	208
Table 10.3.	Value of Gant Real Estate with and without project	214
Table 10.4.	Low-risk project versus high-risk project.	215
Table 10.5.	Agency problems between shareholders and managers (in million euros)	219
Table 11.1.	Dividend yield of several Belgian companies in 2011.	225
Table 11.2.	Real rates of return on the Brussels Stock Exchange, 1840–2008 . . .	225
Table 14.1.	The financing of Belgian companies as a percentage of the assets . .	298
Table 14.2.	Structure of liabilities before financing, after financing with bonds with warrants, and after exercise of the subscription right (example in thousands of euros) . .	315
Table 15.1.	Projected income statement	343
Table 15.2.	Calculating the operating cash flow	344
Table 15.3.	Transforming sales into cash	344
Table 15.4.	Cash flow table: free cash flow of the company	345
Table 15.5.	Total cash flow of the company	346
Table 15.6.	Sensitivity of ending cash balance to sales growth	347
Table 16.1.	Conversion matrix between sales and sales receipts (in thousands of euros and as a percentage)	356
Table 19.1.	Income statement and balance sheet for the company <i>Golden Age</i> , year 0.	402

Table 19.2.	Cash flow table for the company <i>Golden Age</i> , year 0	403
Table 19.3.	Projected income statement and cash flow table	405
Table 19.4.	Balance sheet of <i>Golden Age</i> expressed in market values (year 0) . . .	411
Table 20.1.	Purchase and ‘pooling of interests’ method in combination of companies (in millions of euros)	422
Table 20.2.	Influence of an acquisition on earnings per share	426
Table 20.3.	Market value before and after acquisition	428
Table 20.4.	Characteristics of the acquisition of GEC by ATA	430
Table 20.5.	Value per ATA share after the acquisition of GEC	431
Table 21.1.	Relationship between required rate of return and evolution of the enterprise value (initial value: 100)	451

List of figures

Figure 1.1.	Classification of the financial function	10
Figure 2.1.	Value of 1 euro invested for n years at various interest rates	25
Figure 2.2.	Current or present value of 1 euro, received after n years, at various discount factors	26
Figure 3.1.	Value of a loan with nominal value 1,000 and 5% coupon interest rate, depending on the required rate of return and the remaining term	39
Figure 3.2.	Value of a zero-coupon bond with a nominal value of 1,000, depending on the required rate of return and the remaining term.	44
Figure 4.1.	Share rate of return and risk-free rate of return.	58
Figure 4.2.	Normal distribution of the rate of return	60
Figure 4.3.	Utility function of a risk-averse investor	61
Figure 4.4.	Utility function of a risk-neutral investor.	63
Figure 4.5.	Utility function of a risk-seeking investor	64
Figure 4.6.	The rate of return pattern for 3 shares A, B and C.	66
Figure 4.7.	Relationship between the efficient set and the utility function	67
Figure 4.8.	Expected rate of return of four shares.	68
Figure 4.9.	Relationship between expected rate of return, risk and utility function	69
Figure 4.10.	Risk and rate of return on portfolios with shares in Bekaert and Colruyt	74
Figure 4.11.	The opportunity set and the efficient set for various investment opportunities	76

Figure 4.12.	The effect of diversification on a portfolio's risk	77
Figure 4.13.	The opportunity set for a risk-free and a risky investment	79
Figure 4.14.	The Capital Market Line	80
Figure 4.15.	Relationship between required rate of return and risk	83
Figure 4.16.	Impact of market movements on the <i>ex post</i> rate of return	86
Figure 5.1.	Value for the buyer of a call option with an exercise price of 1,000 euros on exercise date	102
Figure 5.2.	Value for the buyer of a call option with an exercise price of 1,000 euros on the exercise date	103
Figure 5.3.	Value for the writer of a call option with an exercise price of 1,000 euros on the exercise date	104
Figure 5.4.	Value for the writer of a put option with an exercise price of 1,000 euros on the exercise date	104
Figure 5.5.	Value of an option before exercise date.	107
Figure 5.6.	Probability density of the share price on exercise date.	111
Figure 5.7.	Call on the Yucca plc share.	116
Figure 5.8.	Value of a portfolio consisting of a put and a share on the exercise date	120
Figure 6.1.	Link between the required rate of return k and the net present value NPV.	142
Figure 6.2.	Multiple internal rates of return.	144
Figure 6.3.	NPV in function of the required rate of return for projects X and Y.	145
Figure 8.1.	Required rate of return for an individual investment project	176
Figure 9.1.	The relationship between EBIT and EPS for different financing alternatives.	188
Figure 9.2.	First proposition of M&M	192
Figure 9.3.	The impact of the tax advantage on the value of the company	194
Figure 9.4.	Return on equity and effective tax rate (nominal tax rate = 34%, notional interest deduction rate = 4%) . . .	196
Figure 9.5.	Value of the company with tax advantage and bankruptcy costs . . .	202
Figure 12.1.	Romulus profit and dividend per share.	249

Figure 12.2.	Remus profit and dividend per share	249
Figure 12.3.	The net dividend and earnings per share of Bekaert 1998–2011.	250
Figure 14.1.	Value of a bond with a call option	311
Figure 14.2.	Value on the exercise date and market value of a warrant	316
Figure 14.3.	Premiums above bond value and conversion value	322
Figure 15.1.	Hedging approach to financing	336
Figure 15.2.	The net working capital of a company	338
Figure 15.3.	The working capital requirement based on a company's operating cycle	339
Figure 15.4.	The working capital requirement of distribution companies.	340
Figure 16.1.	Relationship between credit standard on the one hand, and sales, cash sales, bad debt losses and result on the other hand	357
Figure 16.2.	Sequential credit analysis	360
Figure 17.1.	Relationship between the interest cost of the supplier credit and the length of the credit period for a discount percentage of 2%.	372
Figure 17.2.	Liabilities with respect to salaries	375
Figure 17.3.	Liabilities relating to dividends	376
Figure 18.1.	The inventory model, applied to cash management	385
Figure 18.2.	Conversion costs, interest costs and total costs as a function of conversion amount C	386
Figure 18.3.	Miller–Orr Model	388
Figure 18.4.	Relationship between maturity and rate of return on an investment	390
Figure 18.5.	Investment strategy as a function of the projected cash position	391
Figure 19.1.	Explicit planning period and residual value.	406
Figure 21.1.	Typical cash flow pattern of a start-up company.	442
Figure 21.2.	The Anglo-Saxon venture capital model.	446
Figure 21.3.	Professional versus private investors.	447
Figure 21.4.	Typology of venture capitalists.	448

Figure 22.1.	Example of interest rate parity	463
Figure 22.2.	International parity relations	466
Figure 22.3.	Example of a currency swap	472

6 Assessing investment projects

Introduction	131
6.1. Determining cash flows	131
6.2. Example: an expansion investment	134
6.3. Evaluation methods	138
6.4. Comparison of net present value and internal rate of return	142

Introduction

So far, we have determined the economic value of financial instruments such as shares, bonds and options. This chapter will assess the value of investment projects in the real economy: is it economically interesting for a company to carry out an investment project? Does a project create value for the company and for the shareholders?

An investment project requires the spending of a certain amount today, in the hope of receiving greater – but uncertain – amounts in the future thanks to the project. This chapter examines the relevant cash flows and how current and future cash flows can be compared to determine the rate of return on an investment project.

Once again, as is always the case in financial decisions, cash flow is used, and not accounting profit figures. In determining the value of a share, the present value of the dividends expected in the future is calculated, taking into account the required shareholder rate of return. To know the value of a bond, the total value of the future interest and the nominal value of the bond at the end of the term are recalculated towards today. After all, dividends, interest and nominal value are the income that investors receive. The same principle applies when assessing investment projects: the value of a project is defined as the current value of all the cash flows generated by the project, taking into account the required rate of return on the investment project. This chapter assumes that the required rate of return is known. Determining the required rate of return is discussed in chapter 8. First, a detailed examination is made of how the relevant cash flows are determined. Then, the prevailing investment assessment techniques are discussed. Chapter 7 deals in more detail with a number of advanced aspects, such as inflation and options in investment projects.

6.1. Determining cash flows

6.1.1. General basic principles

To determine the economic value of an investment project, all cash flows generated by the project must first be identified. Only those cash flows generated by the project are eligible, but care must be taken to ensure that all cash flows are considered. This principle is simple, but in practice this is the most difficult phase in assessing the value of an investment project.

The basic principles:

- Only cash flows (income and expenses) are relevant, not accounting loss or profit figures. Revenues and costs should be considered only to the extent that they entail income and expenses;

- Only the cash flows generated by the project are important. We call these the marginal or incremental cash flows. Cash flows that are independent of whether or not the project is executed, are irrelevant to the investment decision;
- No account is taken of financial flows (such as interest payments on or the repayment of loans, or dividends on new capital) when determining cash flows, but only of operating flows. The financing cost, after all, will be taken into account when determining the minimum required rate of return. Whether an investment project is financed with a new loan, with surplus liquid assets or with newly issued share capital is therefore irrelevant;
- However, the effect of the investment project on taxes *is* taken into account, since paying taxes results in an outgoing cash flow. The relevant tax rate is the marginal tax rate, not the average tax rate of the company. After all, the extra profit of the project will be taxed at the marginal tax rate – i.e. the highest rate to which the company is subject – and not at the average tax rate.

Before fleshing out these basic principles using examples, some pitfalls that often occur in practice are considered.

6.1.2. Sunk costs

A 'sunk cost' is an expense that happened in the past. Since expenses that have been incurred in the past cannot be reversed, and therefore cannot be influenced by the decision whether or not to invest (further), they are not expenses caused by the project and should not be taken into account.

Example 1

The company *Pharmaceutica* has already invested ten million euros in research and development into a specific new drug. The drug was successfully tested on animals. Before being allowed to market the drug, it needs to be further tested on healthy people to determine its side effects. If this phase is successfully completed, it must still be tested on sick people to check whether it effectively fights the intended disease. These two test phases in turn require investments of millions of euros. When deciding whether or not to start the next test phase, the research work already performed is irrelevant. These expenses have been incurred in the past and therefore have no effect on the future investment. It is the future that is important. What is the probability of successfully completing the following test phases? If the drug is finally put on the market, what is the estimated market size, sales price, etc.?

Example 2

The company *Orient Exploder* is considering an opportunity to take over the Chinese fireworks market. Last year it built a first test factory and sold its fireworks on the local market. This of course was a significant investment. However, the test showed that professionally produced fireworks are too expensive for the local population, which prefers cheaper (but more dangerous) fireworks. *Orient Exploder* sees no possibility of reducing

production costs. The fact that the test investment was substantial does not affect the decision whether or not to continue with the Chinese project. Only future investments, future expenses and future income are important. The test investment was a good way to get to know the market, but the expenses already incurred in the past are irrelevant to the current decision whether or not to invest in expansion. The decision to build a test factory was of course an investment decision. Moreover, it was not *a priori* a bad decision, even if it later turns out that the follow-up investment will not take place. After all, the initial investment made it possible for *Orient Exploder* to better understand the market and gather essential information to properly assess the further investment.

6.1.3. Opportunity costs

A company owns an asset (for example a piece of land or a building) that will be used in an investment project. If the project is executed and the resource used, an alternative use is excluded. Potential revenue from a different use is therefore lost. The use of the resource therefore represents an opportunity cost, because the company loses the alternative revenue from the assets if the project is executed. Opportunity costs must therefore be taken into account in the investment project, even if they do not entail immediately visible cash implications.

Example

A company has long owned an unused storage space in the South of France, with an estimated resale value of 1 million euros. It has a project to develop the Southern European market. In this project, the storage space is used as a place to hold intermediate stock in the vicinity of the Southern European market. Should the value of the storage space be included in the assessment of the investment project?

Yes, the fact that the storage space has long been in the possession of the company is irrelevant here. If the project is implemented, the storage space can no longer be used for other purposes. The most obvious alternative is the sale of the storage space for 1 million euros. Hence the current market value of the storage space must be considered as an expense at the start of the project. After all, if the project is not implemented, the land and storage space can immediately be sold for 1 million euros and the company receives an immediate income from its sale.

6.1.4. Side effects

Another difficulty in determining the incremental cash flows is the fact that the change in cash flows throughout the entire company must be taken into account. For example, the introduction of a new product may have a negative impact on sales of other products in another department of the same company. When assessing this “introduction of a new product” project, this negative consequence must be fully taken into account.

6.1.5. The useful life of the project

The relevant expected life over which the cash flows must be determined is the economic life of the project. The tax life (over what period will the investment be depreciated?) is irrelevant. If the investment still generates cash income and expenses after the depreciation period, these must also be taken into account.

6.2. Example: an expansion investment

In order to flesh out the foregoing, an example is elaborated below. *Newprod PLC* is considering the introduction of a new product. In order to get to know the market of the new product, a short market survey has already been carried out by an external agency, for which 20 000 euros were paid. Based on this study, additional sales are expected as shown in Table 6.1. This projection is based on the volumes that are expected to be sold and the expected selling price per unit. It is also expected that the product will remain on the market for five years. To launch the new product, an investment in a completely new production hall with equipment and a marketing campaign is necessary. The production hall will be built on land for which *Newprod* paid 100 000 euros five years ago. The presumed resale value of this land is now 150 000 euros. The expected lifespan of the production hall is 33 years, the lifespan of the equipment is five years.

In order to produce and distribute the new products, raw materials and consumables, services and other goods must be paid for, as well as wages, salaries and other costs; these amounts are shown in Table 6.1. Customers are expected to pay after an average of 30 days, and suppliers will be paid within the same time frame. Stock equivalent to two weeks of sales must be maintained. At the end of the five-year period, the stock will be phased out, all suppliers will be paid, and all outstanding customer receivables will be collected.

Is this an interesting opportunity?

Table 6.1. Cash flows from the investment project (all amounts in 1 000 euros)¹⁷

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
<i>Impact on the result of the company</i>						
(1) Revenue		100.0	180.0	250.0	250.0	120.0
(2) Raw materials and consumables, services and other goods		-40.0	-72.0	-100.0	-100.0	-48.0
(3) Wages and salaries		-20.0	-22.0	-22.0	-22.0	-18.0
(4) Depreciation		-72.0	-72.0	-72.0	-72.0	-72.0
(5) Operating profit before taxes ¹ = (1) + (2) + (3) + (4)		-32.0	14.0	56.0	56.0	-18.0
(6) Additional taxes: 40% marginal tax rate		12.8	-5.6	-22.4	-22.4	7.2
(7) Operating profit after taxes = (5) + (6)		-19.2	8.4	33.6	33.6	-10.8
<i>Operating cash flows</i>						
(8) Operating cash flow after taxes (7) - (4)		52.8	80.4	105.6	105.6	61.2
(9) Change in working capital requirement		-6.5	-5.3	-4.5	0.0	16.3
(10) Inventories		1.5	2.8	3.8	3.8	0.0
(11) Trade receivables		8.3	15.0	20.8	20.8	0.0
(12) Supplier credit		3.3	6.0	8.3	8.3	0.0
(13) Need for net working capital (10) + (11) - (12)		6.5	11.8	16.3	16.3	0.0
<i>Investment cash flow</i>						
(14) Equipment	-300.0					
(15) Production hall	-400.0					339.4
(16) Land	-150.0					150.0
(17) Market research	-					
(18) Total (initial) investment (14) + (15) + (16) + (17)	-850.0					489.4
Free cash flow (8) + (9) + (18)	-850.0	46.3	75.1	101.1	105.6	566.9

¹⁷ Operating profit before taxes is also called EBIT (Earnings Before Interest and Taxes).

6.2.1. Determining the impact on the annual result

Although the value of the project has to be assessed on the basis of the cash flows, measuring the impact of the investment on the annual operating results is nevertheless started, since this determines how taxes (which do indeed generate a cash flow) are influenced by the project.

The budgeted surplus revenues and additional costs are shown in Table 6.1. Sales of the new products in the first year are not yet up to speed. Only in year 3 and 4 are top sales expected. Sales decline during the fifth year, at the end of the project's life. The raw materials and consumables as well as services and other goods are variable and follow the sales. Wages are partially variable, but also partially fixed, which explains why wages do not rise or fall as much compared with sales. Depreciation, i.e. the sum of the annual depreciation of the building and equipment, is of course fixed.

There are more costs than revenue in the first year, which affects the result negatively. Thus *Newprod PLC* will pay less taxes (assuming that the company as a whole realises more than 32 000 euros in operating profit). The decreased amount of taxes represents an opportunity revenue for the current investment project. The same situation occurs in year 5, when sales are lower, but fixed costs (such as depreciation) continue. In years 2, 3 and 4 there are more revenues than costs, so that more taxes will have to be paid.

Note that possible financial costs are not taken into account. Financial costs are included in the minimum required rate of return on the investment.

6.2.2. Determining the change in the need for net working capital

The annual operating cash flow after taxes is equal to the annual operating results after taxes, plus the non-cash costs, in this example equal to the depreciation. Thus in year 1, net operating cash flow amounted to 52 800 euros. However, this amount was not fully received in year 1. *Newprod PLC* will need additional net working capital if the project is executed.

Because sales are only paid after 30 days, not all revenue is income from that same year. The outstanding customer receivables at the end of each year therefore amount to one twelfth of the total sales, assuming that the sales are spread evenly over the year. In addition, a stock of products will be created, equivalent to two weeks of sales. At the end of each year there will be stock equal to one twenty-sixth of the cost price of the goods (estimated at 40% of the sales price). This stock must be purchased and paid for. This is therefore also an investment for *Newprod PLC* attributable to the project. The expenses related to raw materials, auxiliary materials, services and other goods are

also not paid immediately: suppliers grant an average payment extension of 30 days. The need for net working capital is created by the stock, increased by the customer receivables and reduced by the supplier payables.¹⁸

The annual increase in the required net working capital is an investment. Holding more working capital means that extra cash resources are invested in the operation of the company. On the other hand, a decrease in the net working capital requirement is equivalent to a divestment: there is additional cash revenue due to the reduction of inventories and customer receivables. At the end of the project's life (year 5), the net working capital is fully reduced. Since there will no longer be sales after year 5, there will also be no stock, no customer receivables and no supplier credit. In year 5, therefore, there is an extra cash flow thanks to the reduction of the working capital requirement.

6.2.3. Determining investment cash flows

The initial investment is caused by the construction of the production hall, the purchase and installation of the equipment and the opportunity cost of the land on which it is built. The purchase and installation of the equipment is estimated at 300 000 euros. This amount includes all the additional expenditure that this entails, such as adjustments to other production entities, staff training, etc. The equipment is depreciated on a straight-line basis over 5 years, the lifespan of the equipment.

Construction of the production hall costs 400 000 euros; the building is depreciated on a straight-line basis over 33 years. Since the building (unlike the equipment) is still usable at the end of the project, the residual value of the building must be taken into account. The probable residual value of the building is equal to its book value after 5 years.¹⁹ Annual depreciation for the building amounts to 400 000 euros / 33 = 12 121.21 euros. After 5 years, the carrying amount of the building is therefore equal to 339 393.94 euros. This amount is considered a positive cash flow for the current project. After all, if the project is executed, the building can be used for other projects after 5 years or sold for – presumably – the book value. The market value of all remaining assets at the end of the project's life can thus be considered as an income that benefits the project.

Account is taken of the value of the land: 150 000 euros. This is an opportunity cost that must be charged to the project. The fact that 100 000 euros were paid in the past for the land is irrelevant. The past is not important for the current investment decision.

¹⁸ If there are other operating debts, such as debts in relation to staff or social security contributions, these must also be taken into account. These debts also reduce the need for net working capital.

¹⁹ If the probable market value differs from the book value, the tax effect must be taken into account. In the case of a capital loss, there will be a tax advantage; in the case of a capital gain, a tax disadvantage.

If the project is now implemented, the land can no longer be used for other purposes or sold. Sale of the land would yield 150 000 euros, making this amount the relevant opportunity cost. Like the building, however, here too, the land still has a value at the end of the project. Land is not depreciated; it is assumed that the probable market value after 5 years will be unchanged compared to the value today.

Note that the cost of the market research is not taken into account. After all, this is a sunk cost that happened in the past and is irreversible. Whether or not the investment project is carried out, has no longer impact on the expense caused by this market research.

The free cash flow related to the investment project consists of the sum of the operating cash flow after taxes, the change in the need for net working capital, and the investment cash flow.

$$\begin{aligned}\text{Free cash flow} &= \text{Operating cash flow after taxes} \\ &+ \text{Change in net working capital requirement} \\ &+ \text{Investment cash flow}\end{aligned}$$

6.3. Evaluation methods

Once the free cash flows of the project have been determined, it must be determined whether the investment creates or destroys value. In what follows, the most commonly used techniques to assess investments will be discussed and evaluated.

6.3.1. Average book profitability

Definition

The average book profitability is the average annual after-tax profit generated by the project divided by the average carrying amount of the investment over the life of the project.

$$\text{Average book profitability} = \frac{\text{Average annual after-tax profit}}{\text{Average carrying amount of the investment}}$$

Applied to the above example:

$$\text{Average book profitability} = \frac{(-19 + 8 + 34 + 34 - 11) / 5}{(850 + 778 + 706 + 634 + 562 + 489) / 6} = 1.4\%$$

Book profitability is compared to the minimum rate of return required, to determine whether or not the project will be accepted.

Objections

- this method is based on profit and not on cash flows;
- it does not take into account the timing of cash income and expenses;
- it is not clear what a correct book profitability requirement should be.

For all these reasons, it is not advisable to use average book profitability as an evaluation method.

6.3.2. Payback period

Definition

The payback period is the number of years necessary to recoup the initial investment. Applied to the example, this is 5 years: it is only at the end of the project's life that the initial investment is fully recuperated. If the annual cash flows are constant, the payback period is equal to:

$$\text{Payback period} = \frac{\text{Initial investment}}{\text{Annual net cash receipts}}$$

If the payback period is less than or equal to the maximum permitted payback period, the project is accepted. If not, it is rejected.

Objections

- this method does not take into account the cash flows after the end of the payback period;
- it does not take into account the size and timing of the cash flows during the payback period.

Despite these objections, the payback period is often used in practice, usually in addition to other, more advanced methods. This method provides a certain insight into the risk and liquidity of a project: the shorter the payback period, the smaller the risk and the greater the liquidity of the project. However, it should be noted that this method does not include the distribution of the possible outcomes in the analysis and therefore cannot be considered as a good risk indicator. The payback period therefore is better used as additional information, rather than as a rate of return criterion to be maximised.

In some companies, a number of the above-mentioned objections are met by using a “discounted” payback period. In this case, each of the future cash flows is first recalculated, taking into account the required rate of return on the investment project. These discounted cash flows serve as the basis for determining the payback period as

above. The discounted payback period will always be slightly longer than the regular payback period.

While the discounted payback period seems more attractive, the most fundamental objections to the payback period remain. Here too, an arbitrary cut-off point must be determined, and all cash flows after the payback period are ignored.

6.3.3. Internal Rate of Return (IRR)

Definition

The methods based on discounting cash flows take into account the size and time pattern of the cash flows of an investment project and can therefore be regarded as more objective evaluation methods. The two methods that are based on discounting are the internal rate of return method and the net present value method.

The internal rate of return is the interest rate that equates the present value of the expected cash receipts to the present value of the expected cash outflows.

$$A_0 + \frac{A_1}{(1+r)^1} + \frac{A_2}{(1+r)^2} + \dots + \frac{A_n}{(1+r)^n} = \sum_{t=0}^n \frac{A_t}{(1+r)^t} = 0 \quad [6.1]$$

With A_t = incoming or outgoing cash flow in period t
 r = internal rate of return.

In certain (exceptional) situations, more than one internal rate of return is possible. The problem of multiple internal rates of return is discussed at the end of this chapter.

Example

$$-850 + \frac{46}{1+r} + \frac{75}{(1+r)^2} + \frac{101}{(1+r)^3} + \frac{106}{(1+r)^4} + \frac{567}{(1+r)^5} = 0$$

From which it follows: IRR = $r = 1.3\%$

Finding the appropriate value for r cannot be solved using a closed mathematical formula, but must be solved through trial and error. Every spreadsheet and advanced calculator has an IRR financial function that automatically calculates the internal rate of return for a series of cash flows.

Use

If the internal rate of return is greater than the *a priori* determined required rate of return on the investment project, the project is accepted. If not, it is rejected.

Meaning

The IRR method answers the question: “what rate of return does an investment project have on the invested capital?” Applied to the example, this means that the originally invested capital of 850 000 euros will earn a 1.3% rate of return over 5 years.

6.3.4. Net Present Value Method (NPV)

Definition

The net present value method determines the present value of all cash flows of an investment project, given a minimum rate of return, after taxes, required for the investment project:

$$\text{NPV} = A_0 + \frac{A_1}{(1+k)^1} + \frac{A_2}{(1+k)^2} + \dots + \frac{A_n}{(1+k)^n} = \sum_{t=0}^n \frac{A_t}{(1+k)^t} \quad [6.2]$$

with NPV = net present value

k = required minimum rate of return

If the net present value is greater than or equal to 0, the project is accepted. If not, it is rejected. This can also be expressed in the following way: a project is accepted (rejected) if the present value of the cash receipts is larger (smaller) than the present value of the cash outflows. If the NPV is positive, this means that the future cash flows are worth more than the initial investment expenditure, taking into account a predetermined required rate of return on the investment. The NPV of a project shows how much value the project creates for the shareholders, in addition to the minimum required rate of return.

Example (with k = 10%)

$$\begin{aligned} \text{NPV} &= -850 + \frac{46}{1+0.10} + \frac{75}{(1+0.10)^2} + \frac{101}{(1+0.10)^3} \\ &\quad + \frac{106}{(1+0.10)^4} + \frac{567}{(1+0.10)^5} \\ &= -246\,000 \text{ euros} \end{aligned}$$

The project is not accepted since the net present value is negative.

Meaning

The net present value of an investment project indicates how much value the project creates for the company. After all, it is the value of the future cash flows, taking into account the *a priori* required rate of return. With a positive net present value, the initial investment earns the required rate of return during the project's life, and on top of that, value is created equal to the net present value. In the example, value is destroyed if the project is executed: the net present value is negative.

6.4. Comparison of net present value and internal rate of return

Both the internal rate of return and the net present value method take into account all the cash flows of an investment project till the end of the project, and the time value of the money. Thus both methods are clearly preferable to those based on the average book profitability and the payback period, and therefore are often used in practice. Which of the two methods is preferred? First, this chapter will consider how both methods compare when only one project needs to be assessed, then it will look at how they compare when multiple projects need to be assessed.

6.4.1. A single project

If only one project needs to be assessed, in which the cash flows show the classic pattern of a single negative initial investment followed by positive cash flows, the internal rate of return and the net present value method lead to the same decision. Figure 6.1 shows the relationship between the required minimum rate of return k and the net present value for a “normal” investment project, in which the sum of the cash receipts is greater than the sum of the cash outflows, and in which the revenue after expenses falls.

Figure 6.1. Link between the required rate of return k and the net present value NPV

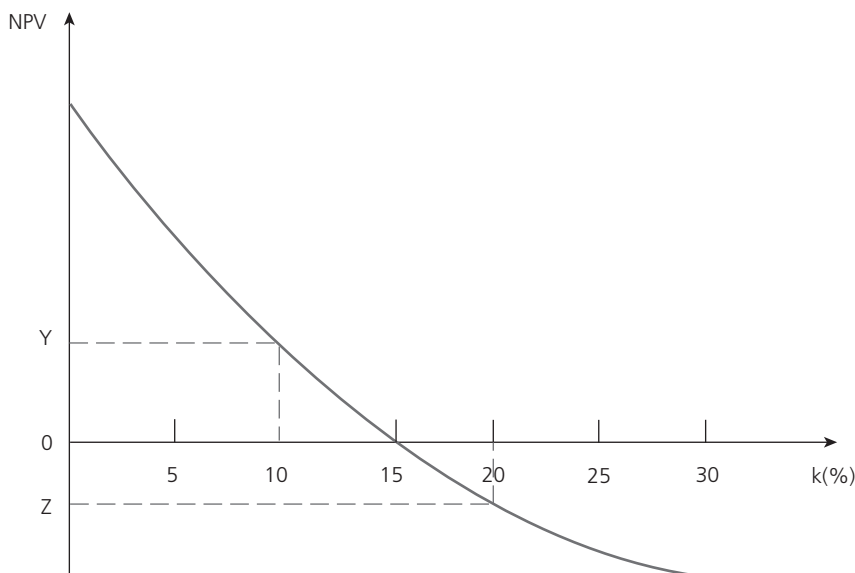


Figure 6.1 clearly shows that in this case, both methods lead to the same decision. In the example of Figure 6.1, the IRR is 15%. If the required rate of return on the project, k , is less than 15% (e.g. 10%), then the NPV is positive (for example Y) and the

$IRR > k$. The project should therefore be executed. If $k > 15\%$ (for example 20%), the NPV is negative (Z for example) and the $IRR < k$. Both methods again lead to the same decision, namely not executing the project.

If the project shows a different cash flow pattern, problems arise with the use of the internal rate of return method. A first problem occurs when the project first generates revenues, and then expenses. A second problem arises when the cash flows of the project change sign more than once during its life.

Example: First cash flow is positive

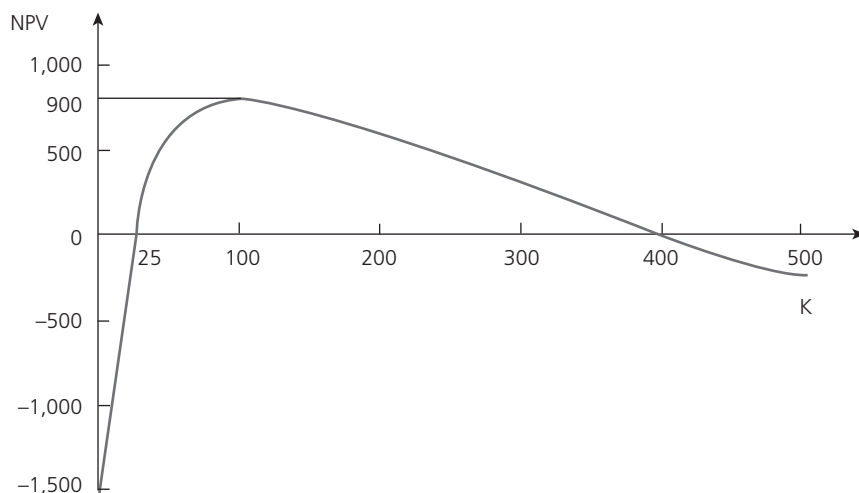
The company *Events* organises shows and events at regular intervals. The clients or spectators pay long before the show takes place. The income is therefore collected before the expenses are paid. The company wants to see whether organising a new show is a good idea. Income is estimated at 100. Expenses are paid the following year; these are estimated at 115. The internal rate of return for this project is 15% . However, in the case of discounting factors less than 15% , the NPV is now negative, and with discount factors greater than 15% , the NPV is now positive: in this case there is a positive relationship between NPV and the discount factor. This makes sense, since the company first receives money, and later must pay money. This is comparable to obtaining a loan, which must later be repaid with interest. In this example, the IRR of 15% can be compared to the interest rate to be paid.

For projects where the initial cash flow is positive, the company obtains financing. In this case, the IRR indicates the cost of the financing. The decision rule to be used in this case is: is the IRR *less* than the minimum required rate of return? In other words, does the financing obtained cost less than the “normal” financing of the company? The decision rule in the case of the NPV method remains the same: the project creates value for the company if the NPV is positive.

Example: Cash flows change sign more than once

A company plans to operate a mine. An initial investment of 1 600 is required to open the mine. In the following year, thanks to the mining operations, a positive cash flow of 10 000 is expected. In the second year, the site will have been completely mined. At that time, however, the mine must be re-closed to prevent accidents and to comply with the relevant environmental regulations. These expenses will amount to 10 000. Are the mining operations profitable, or should we wait for higher prices for the mined metal?

Due to the sign reversal in the cash flows, mathematically this project has two IRRs, or two discount factors in which $NPV = 0$, i.e. $IRR = 25\%$ and $IRR = 400\%$. Figure 6.2 shows how the NPV of this project changes in function of the discount factor.

Figure 6.2. Multiple internal rates of return

If cash flows change sign more than once during the project's life, it is a mathematical fact that there are multiple values for the discount factor at which $NPV = 0$. In theory, a series of cash flows with N sign changes after the initial investment can entail a maximum of N IRRs. Moreover, there can also be projects where there is no IRR.

What is the correct IRR if there is more than one? None of the multiple internal rates of return has economic significance because they are not a measure of the investment value. In this case, the IRR is only a mathematical concept, without business-economic relevance. Again in this case, the NPV results in the correct decision: invest if the NPV is positive, given an assumed required rate of return.

6.4.2. Mutually exclusive projects

Two or more investment proposals are mutually exclusive if the choice for one project excludes the other(s). For example, a company decides to expand its production capacity. For this, it can either expand an existing facility or build a factory at a new location. If a new location is chosen, the existing facility will not be expanded and *vice versa*. If a company decides to purchase a truck and can choose from more than one brand, the choice for one brand will imply that the trucks of other brands are not purchased.

In the case of mutually exclusive projects, IRR and NPV can lead to conflicting conclusions, especially if the initial investment of one project is much larger than the investment in the other project, or if the time pattern of the future cash flows differs greatly.

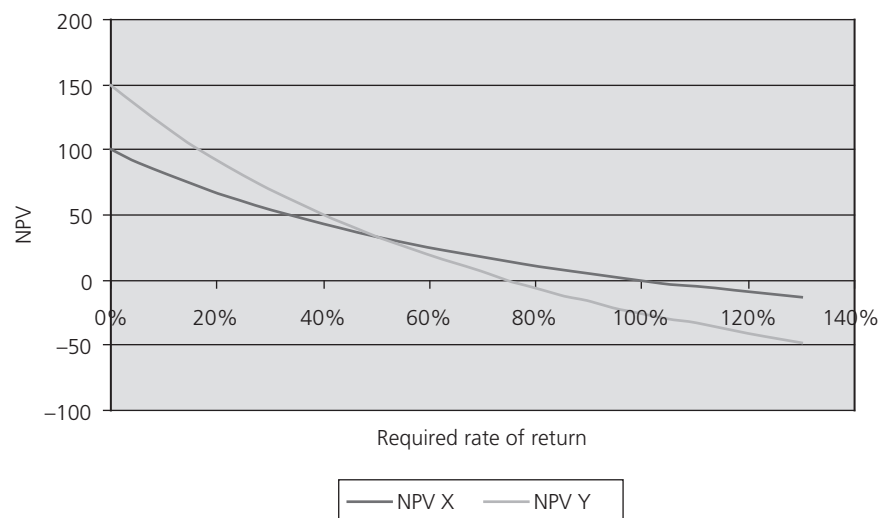
An example illustrates this. Projects A and B are mutually exclusive and have the cash flows contained in Table 6.2. The initial investment for X is 100 and for Y, 200. The minimum required rate of return on both projects is 10%. Project X generates a net present value of 82, while project Y generates a larger net present value of 118. Project X, however, has a larger IRR than project Y: 100% for X versus 75% for Y.

Table 6.2. Cash flows from two mutually exclusive projects

Project	C _{F0}	C _{F1}	IRR	NPV (10%)
X	-100	200	100%	82
Y	-200	350	75%	118

Figure 6.3 shows the evolution of the NPV in function of the minimum required rate of return for projects X and Y. NPV and IRR lead to opposite conclusions, given a required minimum rate of return of 10%: according to IRR, project X is more interesting, while according to NPV, project Y is more interesting. Which is the correct decision?

Figure 6.3. NPV in function of the required rate of return for projects X and Y



It is certain that one of the two projects will be carried out, since both projects have a positive NPV and an IRR that is greater than the required rate of return. The company will therefore certainly invest an amount of 100. The question that now needs to be answered is: “does it increase value to invest an additional 100 and execute project Y instead of project X?”. This additional investment of 100 in year 0 will generate an additional positive cash flow of 150 in year 1. Table 6.3 shows the cash flows of project Y versus project X.

Table 6.3. Cash flows from project Y versus project X

Project	CF ₀	CF ₁	IRR	NPV (10%)
Y – X	–100	150	50%	36

When Y – X (*i.e.* the additional investment of 100 in year 0) is considered as a separate investment project with a required rate of return of 10%, it is clear that this project has an NPV of 36 and an IRR of 50%. The additional investment is clearly profitable and creates value for the shareholders. The correct decision is therefore to execute project Y and not project X. Note that the NPV of project Y is equal to the sum of the NPV of project X and of the NPV of project Y – X. The IRR of project Y is equal to the weighted average of the IRR of project X and of project Y – X. In general, the NPV of a portfolio of different projects is simply the sum of the NPV of the individual projects and the IRR of this portfolio is the weighted average of the individual projects.

Again the NPV method, not the IRR method, leads in this situation to the correct decision. Given the objective of value maximisation of the company, the NPV method is the preferred method in all circumstances. The IRR method only definitively leads to a correct decision if the cash flows do not reverse sign more than once and if a single project needs to be decided. However, in practice the IRR method is often preferred to the NPV method. A frequently heard justification for this is the fact that the IRR method would be simpler, since there is no minimum required rate of return required to calculate the IRR. This is correct. However, this explanation does not take into account the fact that, even if the IRR method is used, a minimum required rate of return must be assumed in order to decide whether or not to carry out a project. After all, the IRR must be greater than the minimum required rate of return before a project creates value for a company.

Solar panels continue to deliver value

Despite the disappearance of the federal tax reduction, the payback time for solar panels will remain 5 years and 6 months. Rien Van den Broek, business manager of RW Solar in Turnhout, explains the calculation.

Green-thinking Belgium woke up with a hangover on 1 January 2012. For the bulk of energy-saving investments, including the installation of solar panels, the popular 40 percent tax reduction had been eliminated.

‘Nevertheless, the payback period for an installation of solar panels remains very acceptable for private individuals’, says Rien Van den Broek of RW Solar, a company that specialises in installing solar panels. ‘We owe this to the falling rates for solar installations. Today we install household installations with at least twenty panels and at least a capacity of 3 800 watt peak for 2 euros per watt peak, a rate that was unthinkable a year ago. And large industrial installations are even more cost effective. For example, we recently submitted a tender of 327 000 euros for a

247 kilowatt-peak system, fully installed, excluding VAT and AC cabling. This corresponds to barely 1.3 euros per watt peak. However, this does require an available surface area of 1 700 m².

Lower energy bill

'Prices fell sharply last year after solar subsidies were scaled back in Germany,' explains Van den Broek. 'Supply surpluses then caused rates to plummet by 20 to 25 percent. As a result, many manufacturers today produce at cost price and the rates for solar installations have fallen to a never-seen minimum.'

Due to this fall in prices, the payback period, even after the loss of the tax reduction, remains very acceptable. Compared to this considerably slimmed-down cost, there are still two indisputable financial advantages. First, the savings on the energy bill. 'All costs included (VAT, network costs, green electricity costs, fixed remuneration, etc.), a private individual easily pays 0.21 euros per kilowatt hour used. This is easy to calculate if you take a look at the energy bill,' notes Van den Broek. 'At this rate, individuals who produce 3 230 kilowatt hours per year with their installation – which corresponds to an installation of 3 800 watt peak – save 678.30 euros per year (or $3\,230 \times 0.21$ euros). This figure is based on the average consumption in Belgium.'

Renewable energy certificates

In this, the proceeds from the renewable energy certificates must also be included. For installations put into operation between 1 January and 1 April of this year, the Flemish Government will guarantee for twenty years a subsidy of 250 euros per 1 000 kilowatt-hours of electricity generated. In the production of 3 230 kilowatt hours from our example, the subsidy amounts to 807.50 euros (3.23×250 euros) per year. If we add that to the savings on the energy bill, we achieve a total financial yield of 1 485.80 euros per year.

Payback time

If we compare this yield with the cost of the solar installation, the result turns out to be surprisingly favourable. 'Those who have a 3 800 watt peak system installed by us at our new rates, including assembly and VAT (6%), pay 2 euros per watt peak or 7 600 euros,' estimates Van den Broek. 'With an annual yield of 1 485.80 euros, this means that this investment is recouped after approximately 5 years and 6 months. After that, the yield becomes pure profit, since the renewable energy certificates are guaranteed for 20 years. And if energy prices continue to rise, the savings on the energy bill will only become greater.'

'These figures clearly show that solar installations can also be profitable without tax relief. We currently see this in the Netherlands, where there are no subsidies for solar energy. There too, solar panels have proven to be a great success, while the payback period there is around 10 years.'

Source: *De Standaard* 7 January 2012.